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# 1. INTRODUCTION

## A. Purpose:

## here we include the goals of the project

The continued increase in carbon emissions will cause global warming and sea level rise, producing climate anomalies, increased desertification area, and increased pests and diseases. If the current rate of carbon emissions continues to develop, the global temperature will rise by 2 to 4 degrees in 2050 [], and the resulting meteorological disasters will damage the ecosystem, cause saltwater intrusion, endanger the living environment of human beings and other organisms on earth. Therefore, the reduction of room temperature gas emissions and the reduction of "carbon footprint" should be the consensus of human beings to achieve sustainable development. In 2022, the United Nations Conference on Environment and Sustainable Development will be held in Stockholm with the theme of a healthy planet for the prosperity of all --our responsibility, our opportunity. However, compared with fuel vehicles, electric vehicles still require longer charging time, while the construction of infrastructure such as charging piles is still imperfect. Therefore, reasonable distribution of charging pile resources and intelligent aggregation of charging pile information can greatly facilitate electric vehicle travel and contribute to the popularity of electric vehicles, thus achieving the goal of reducing carbon footprint.

Our goal is to develop a new system that (i) provides end-users with charging station aggregation query services, preferential information, and charging payment and management functions, as well as intelligent charging planning functions, and (ii) provides Charging Point Operator (CPO) with management and interaction with Distribution System Operator (DSO). The service can optimize the operation process of charging service providers and improve the charging experience of end users.

### 1.1.1 Goals

|  |  |
| --- | --- |
| Goal | Description |
| G1 | Allow the end user to know about the charging stations nearby, their cost, any special offer they have. |
| G2 | Allow the end user to know book a charge in a specific charging station for a certain timeframe. |
| G3 | Allow the end user to know start the charging process at a certain station. |
| G4 | Allow the end user to know notify the user when the charging process is finished. |
| G5 | Allow the end user to know pay for the obtained service. |
| G6 | Suggest the end user to go and charge the vehicle, depending on the status of the  battery, the schedule of the user, the special offers made available by some CPO, and the availability of charging slots at the identified stations. |
| G7 | Allow the CPO to know the location and “external” status of a charging station (number of charging sockets available, their type such as slow/fast/rapid, their cost, and, if all sockets of a certain type are occupied, the estimated amount of time until the first socket of that type is freed). |
| G8 | Allow the CPO to start charging a vehicle according to the amount of power supplied by the socket and monitor the charging process to infer when the battery is full. |
| G9 | Allow the CPO to know the “internal” status of a charging station (amount of energy available in its batteries, if any, number of vehicles being charged and, for each charging vehicle, amount of power absorbed, and time left to the end of the charge). |
| G10 | Provide the CPO the information acquires by the DSOs about the current price of energy. |
| G11 | Provide the CPO the decision which DSOs to acquire energy (if more than one is available). |
| G12 | Provide the CPO the decision where to get energy for charging (station battery, DSO, or a mix thereof dynamically according to availability and cost). |

## B. Scope:

here we include an analysis of the world and of the shared phenomena

### 1.2.1 World Phenomena

|  |  |
| --- | --- |
| Identifier | Description |
| WP1 | The end user arranges schedules. |
| WP2 | The end user books a charge in a charging station. |
| WP3 | The end user starts to charge in a charging station. |
| WP4 | The CPO wants to publish a special offer. |

### 1.2.2 Share Phenomena

|  |  |
| --- | --- |
| Identifier | Description |
| SP1 | Updated relative location of the end-user to charging stations. |
| SP2 | The end user’s charging process at a charging station. |
| SP3 | The end user is asked to pay bills for obtained services |
| SP4 | The end user’s battery statue. |
| SP5 | Updated location and “external” status of charging stations (number of charging sockets available, their type such as slow/fast/rapid, their cost, and, if all sockets of a certain type are occupied, the estimated amount of time until the first socket of that type is freed). |
| SP6 | Updated power supply statue. |
| SP7 | Updated charging process of charging stations. |
| SP8 | Updated price and availability of energy from DSO |

## C. Definitions, Acronyms, Abbreviations

## D. Revision history

## E. Reference Documents

## F. Document Structure

# 2. OVERALL DESCRIPTION

## A. Product perspective: here we include scenarios and further details on the shared phenomena and a domain model (class diagrams and state charts)

## B. Product functions: here we include the most important requirements

## C. User characteristics: here we include anything that is relevant to clarify their needs

## D. Assumptions, dependencies and constraints: here we include domain assumptions

# 3. SPECIFIC REQUIREMENTS: Here we include more details on all aspects in Section 2 if they can be useful for the development team.

## A. External Interface Requirements

### A.1 User Interfaces

### A.2 Hardware Interfaces

### A.3 Software Interfaces

### A.4 Communication Interfaces

## B. Functional Requirements: Definition of use case diagrams, use cases and associated sequence/activity diagrams, and mapping on requirements

## C. Performance Requirements

## D. Design Constraints

### D.1 Standards compliance

### D.2 Hardware limitations

### D.3 Any other constraint

## E. Software System Attributes

### E.1 Reliability

### E.2 Availability

### E.3 Security

### E.4 Maintainability

### E.5 Portability

# 4. FORMAL ANALYSIS USING ALLOY:

This section should include a brief presentation of the main objectives driving the formal modeling activity, as well as a description of the model itself, what can be proved with it, and why what is proved is important given the problem at hand. To show the soundness and correctness of the model, this section can show some worlds obtained by running it, and/or the results of the checks performed on meaningful assertions.

# 5. EFFORT SPENT:

In this section you will include information about the number of hours each group member has worked for this document.

# 6. REFERENCES